

## CLAIMS

We claim:

1. A method of extracting copper from a copper-containing mineral comprising:  
adding a lixiviant and a silica-containing compound or titanium-containing compound to a  
5 copper-containing mineral, forming a composition;  
separating the copper extracted from the composition.
2. The method of claim 1, wherein the concentration of the silica-containing compound or  
titanium-containing compound is at least 5 gm/liter in the composition.
- 10 3. The method of claim 1, wherein the lixiviant is one or more selected from the group  
consisting of: ferric ion, oxidants, hydrogen peroxide, ethylene glycol, chlorate, permanganate,  
bleach, iodide and bacteria.
- 15 4. The method of claim 3, wherein the lixiviant is one or more selected from the group  
consisting of: ferric ion, hydrogen peroxide and ethylene glycol.
5. The method of claim 1, further comprising applying ultraviolet light to the composition.
- 20 6. The method of claim 1, further comprising adjusting the pH of the composition to acidic.
7. The method of claim 1, further comprising adjusting the temperature of the composition  
to between about 25 and 85°C.
- 25 8. The method of claim 1, wherein the mineral further comprises sulfur.
9. The method of claim 8, wherein the mineral is chalcopyrite.
10. The method of claim 1, wherein the silica-containing compound or titanium-containing  
30 compound has a particle size of less than about 200 microns.
11. The method of claim 1, wherein the titanium-containing compound is titanium dioxide.

12. The method of claim 1, wherein the silica-containing compound is selected from the group consisting of:  $\text{SiO}_2$ , silicic acid, fluorosilicic acid, glass sand, borosilicate, dissolved silica, silica gel and colloidal silica.

5 13. A method of extracting copper from a sulfur-containing copper mineral comprising:  
adding a lixiviant and a silica-containing compound or titanium-containing compound to a sulfur-containing copper mineral, forming a composition;  
adjusting the pH of the composition to be acidic;  
adjusting the temperature of the composition to between about 25 and 85°C; and  
10 separating the extracted copper from the composition.

14. The method of claim 13, further comprising adding ultraviolet light to the composition.

15 15. The method of claim 13, wherein the lixiviant is one or more selected from the group consisting of: ferric ion, hydrogen peroxide, chlorate, ethylene glycol, permanganate, bleach, iodide and bacteria.

16. The method of claim 15, wherein the lixiviant is one or more selected from the group consisting of: ferric ion, hydrogen peroxide and ethylene glycol.

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17. The method of claim 13, wherein the sulfur-containing copper mineral is chalcopyrite.

18. The method of claim 13, wherein the titanium-containing compound is titanium dioxide.

25 19. The method of claim 13, wherein the silica-containing compound is selected from the group consisting of:  $\text{SiO}_2$ , silicic acid, fluorosilicic acid, glass sand, borosilicate, dissolved silica, silica gel and colloidal silica.

20. The method of claim 1, wherein the silica-containing compound or titanium-containing  
30 compound has a particle size of less than 200 microns.

21. A method of extracting copper from a sulfur-containing copper mineral comprising:  
adding one or more lixiviants selected from the group consisting of: ferric ion, hydrogen peroxide and ethylene glycol, and a silica-containing compound or titanium-containing  
35 compound to a sulfur-containing copper mineral, forming a composition, wherein the

concentration of sulfur-containing copper mineral:silica-containing compound or titanium-containing compound is about 1:1;

adjusting the pH of the composition to be acidic;

adjusting the temperature of the composition to above about 45 °C;

- 5 applying ultraviolet light to the composition; and
- separating the extracted copper from the composition.